CofC. 18/16/E

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patentees: Keisuke BAN, *et al.* Issued: June 8, 2004

Patent No.: ~~6,745,267~~ 6745816 B2

For: **METHOD OF CASTING AND CASTING MACHINE**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REQUEST FOR CERTIFICATE OF CORRECTION UNDER 37 C.F.R. 1.322 OFFICE MISTAKE

Sir:

Transmitted herewith in duplicate is PTO Form 1050 Certificate of Correction for the above-identified U.S. Patent correcting the Office mistakes as shown in the enclosed Certificate of Correction form. The corrections for the Office mistakes are reflected in the attached copy of the Supplemental Amendment. Also attached is a copy of the facsimile confirmation sheet, evidencing the filing of the Supplemental Amendment with the U.S. Patent and Trademark Office on December 30, 2003. Also attached is a copy of the Letters Patent for the above-referenced patent, with the requested correction marked in red ink.

Since the claims were correctly shown, issuance of a Certificate of Correction is in order. Since these errors were due to the Patent and Trademark Office, no fee is submitted herewith.

If any errors are determined to be on part of the applicants, please charge all necessary fees to attorney's deposit account no. 23-1951.

Respectfully submitted,

Andrew M. Calderon
Reg. No. 38,093

Date: August 3, 2004

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

Ban Keisuke et al.

Serial No.: 09/852,267

Filed: May 10, 2001

For: **METHOD OF CASTING AND CASTING MACHINE**

Docket No. 02410282US

Group Art Unit: No. 1725

Examiner: KUANG Y. LIN

Mail Stop: non final amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUPPLEMENTAL AMENDMENT

Sir:

As a supplemental to the Amendment filed on December 10, 2003, please amend the above-identified application as follows.

Applicants attach hereto a check in the amount of $86.00 for the net addition of one independent claim. Applicants believe that no extensions of time are required at this time. However, if further extensions of time or fees for additional claims are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. §1.136(a), and any fees required therefor (including fees for net addition of claims) are hereby authorized to be charged to our Deposit Account No. 23-1951.

AMENDMENT TO THE CLAIMS

IN THE CLAIMS:

Please cancel claim 2 and add new claim 32. Also, please amend claims 1, 3, 20 and 29-31 as follows. A status of all the claims is provided below.

1. (currently amended) A method of <u>gravity die</u> casting in a casting machine including a casting die, in which a feeder head is provided between a metal inlet and a cavity and in which heat insulating of the feeder head is greater than that of the cavity so as to make cooling rate of the feeder head lower than that of the cavity, said method comprising the steps of:

pouring molten metal into the cavity;

reacting the molten metal with a deoxidizing compound in the cavity so as to deoxidize an oxide film formed on a surface of the molten metal; and

supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked,

<u>wherein the cooling rate of an uncoated portion of the cavity is 500 °C/min or more and the cooling rate of the feeder head is less than 500 °C/min.</u>.

2. (cancel)

3. (currently amended) The method according to claim 1,

wherein the molten metal is aluminum or aluminum alloy,

the cooling rate of the molten metal in the cavity is adjusted to make average ~~clearance between~~ dendrite[[s]] <u>spacing</u> of solidified aluminum or aluminum alloy in the cavity less than 25 μm, and

the cooling rate of the molten metal in the feeder head is adjusted to make average ~~clearance between~~ dendrite[[s]] <u>spacing</u> of solidified aluminum or aluminum alloy in the cavity 25 μm or more.

4. (previously presented) The method according to claim 1,

wherein an inner face of the feeder head is coated with heat insulating lubricant, and

an inner face of the cavity is free of heat insulating lubricant.

5. (original) The method according to claim 1,

wherein the heat insulating of a material of the casting die, which forms the feeder head, is greater than that of a material of the casting die, which forms the cavity.

6. (original) The method according to claim 1,

wherein temperature of an inner face of the cavity is less than 300 °C while casting.

7. (original) The method according to claim 1,

wherein an inner face of the cavity is compulsory cooled by cooling means.

8. (original) The method according to claim 1,

wherein an adapter of the casting die is detachably attached to a cavity part of the casting die.

9. (original) The method according to claim 1,

wherein an adapter of the casting die includes: the feeder head; a first path for introducing the molten metal to the feeder head; and a second path for introducing a material of the deoxidizing compound to the cavity so as to form the deoxidizing compound in the cavity.

10. (original) The method according to claim 1,

wherein the molten metal is aluminum or aluminum alloy, and

the deoxidizing compound is magnesium nitride compound, which is formed by reacting a magnesium gas on a nitrogen gas.

11.-19. (previously canceled)

20. (currently amended) A method of gravity die casting in a casting machine including a casting die, said method comprising the steps of:

pouring molten metal into a cavity of the casting die by pouring molten metal through a feeder head;

setting a cooling rate of the molten metal filled in an uncoated area of the cavity at about 500°C/min. or more and a cooling rate of the molten metal poured into the feeder head portion at about 500°C/min. or less to provide an average dendrite size to increase fluidity and toughness;

reacting the molten metal with a deoxidizing compound in the cavity so as to deoxidize an oxide film formed on a surface of the molten metal;

solidifying the molten metal filled in the cavity; and

supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked.

21. (previously presented) The method according to claim 20, wherein:

an inner wall surface of the cavity is free from the heat insulating treatment; and

coating the feeder head with a heat insulating lubricant.

22 (previously presented)) The method according to claim 21, wherein the deoxidizing compound is formed in the cavity.

23. (previously presented) The method according to claim 20, further comprising:

introducing a first substance and carrier agent into another path in the feeder head to enter into the cavity;

introducing a second substance directly into the cavity,

wherein the first substance and the second substance form the deoxidizing compound on walls of the cavity prior to the pouring step.

24. (previously presented) A method according to claim 23, wherein the carrier agent and first substance are mixed in a heated receptacle and the carrier agent transfers the first substance from the heated receptacle to the cavity.

25. (previously presented) The method according to claim 20, wherein:

the molten metal is aluminum or an aluminum alloy, and

a magnesium-nitrogen compound which is obtained by allowing a magnesium gas and a nitrogen gas as raw materials to be reacted with each other in the cavity is used as the deoxidizing compound.

26. (previously presented) The method according to claim 20, wherein in the solidifying step, a difference of a cooling rate between the molten metal filled in the feeder head and the molten metal filled in the cavity is set to be about 200^{0}C/min or more.

27. (previously presented) The method according to claim 20, further comprising preventing a blocking of the deoxidizing compound by arranging a molten metal-introducing passage that introduces the molten metal into the feeder head and an introducing passage that introduces a raw material of the deoxidizing compound into the cavity.

28. (previously presented) The method according to claim 20, wherein the cooling rate of the molten metal filled in the cavity at about 500°C /min. or more and the cooling rate of the molten metal poured into the feeder head at less than 500°C /min fully secures the difference of solidification time of the molten metal between the molten metal filled in the feeder head and the molten metal filled in the cavity.

29. (currently amended) A <u>gravity die</u> casting method, comprising the steps of:

pouring molten metal into a cavity of the a molding die;

reducing an oxide film formed on a surface of the molten metal by allowing the molten metal and a substance of the deoxidizing compound from a heated receptacle to flow into contact in the cavity;

reacting the molten metal with the deoxidizing compound, a substance of which is carried separately in the cavity, so as to deoxidize an oxide film formed on a surface of the molten metal;

solidifying the molten metal filled in the cavity; and

supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked.

30. (currently amended) A gravity die casting method, comprising the steps of:

pouring molten metal into a cavity of the a molding die;

forming a deoxidizing compound in the cavity by:

introducing a first substance in the cavity which acts to provide the cavity in a non oxidizing atmosphere; and

introducing a second substance in the cavity, separate, from the first substance, to mix with the first substance to form the deoxidizing compound;

reacting the molten metal with the deoxidizing compound in the cavity so as to deoxidize an oxide film formed on a surface of the molten metal;

solidifying the molten metal filled in the cavity; and

supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked.

31. (currently amended) A gravity die casting method, comprising the steps of:

pouring molten metal into a cavity of the a molding die;

providing a carrier agent into a heated receptacle which holds a substance of a deoxidizing compound,

introducing the substance into the cavity by using the carrier agent to form the deoxidizing compound in the cavity;

reducing an oxide film formed on a surface of the molten metal by allowing the molten metal and the deoxidizing compound from a heated receptacle to flow into contact in the cavity;

reacting the molten metal with the deoxidizing compound in the cavity so as to deoxidize an oxide film formed on a surface of the molten metal;

solidifying the molten metal filled in the cavity; and

supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked.

32 (new) A method of gravity die casting in a casting machine including a casting die, in which a feeder head is provided between a metal inlet and a cavity and in which heat insulating of the feeder head is greater than that of the cavity so as to make cooling rate of the feeder head lower than that of the cavity, said method comprising the steps of:

pouring molten metal into the cavity;

reacting the molten metal with a deoxidizing compound formed in the cavity so as to deoxidize an oxide film formed on a surface of the molten metal; and

supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked.

REMARKS

Claims 1, 3-10 and 20-32 are pending. Claim 2 is cancelled and new claim 32 is added. Claims 1, 3, 20 and 29-31 are amended. No new matter is added.

Examiner Interview

Applicants appreciate the courtesies extended by the Examiner to Applicants' representative during a personal interview conducted on December 12, 2003. During this interview, the claims and prior art were discussed. In accordance with the discussion, claims 1, 3, 20 and 29-31 are amended and claim 32 is added to gain allowance of the claims. Claims 3, 20 and 29-31 are amended for clarity purposes only and not to distinguish over any prior art references, e.g., to revise the preamble only. Claim 1 is amended to include the allowable subject matter of claim 2. Claim 32 is added per the interview and should also be allowable.

Claim 1 may be directed, for example, to low pressure assist. The low pressure assist may further help in the solidification direction.

Applicants respectfully request that the rejections are overcome and should be withdrawn. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Applicants hereby make a written conditional petition for extension of time, if required. Charge any deficiencies and credit any overpayment of fees to Attorney's Deposit Account No. 23-1951.

Respectfully submitted,

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I hereby certify that I am transmitting the Supplemental Amendment for Application Serial No.: 09/852,267 containing nine (9) pages to the U.S. Patent Office at 703-872-9603 on December 30, 2003.

Andrew M. Calderon
Reg. No. 38,093

\\COM\369361.2

User ID: KBSOSA

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TO: Name: Examiner Lin

Company: USPTO

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Contact Phone Number:

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TO: Examiner Kuang Y. Lin

OFFICE/COMPANY/FIRM: USPTO

LOCATION:

PHONE NUMBER: 571-272-1179 FAX NUMBER: 703-872-9603

FROM: Andrew M. Calderon

OFFICE: Tysons Corner (See list below) DIRECT FAX NUMBER: 703-712-5285

SENDER'S DIRECT DIAL PHONE NUMBER: 703-712-5426

REMARKS: Dear Ex. Lin:
The following is a Supplemental Amendment for US application serial no. 09/852,267. Please contact me if you have any questions.

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ALMATY, KAZAKHSTAN	011-7-3272-60-596-116	011-7-3272-60-596-100	011-7-3272-60-596-100
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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

6745816B2

PATENT NO.: ~~6,745,267~~ B2
DATED: June 8, 2004
INVENTORS: Keisuke BAN, *et al.*

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below.

Column 10,
Line 55, between "shrinked," and "more", Insert --wherein the cooling rate of an uncoated portion of the cavity is 500 °C/min or--.
Line 61, Delete "spacings" and Insert --spacing--.

Column 12,

Line 37, Delete "atmosphere" and Insert --atmosphere;--.
Line 62, Delete "cavity" and Insert --cavity;--.

MAILING ADDRESS OF SENDER:

PATENT NO.: 6,745,267 B2
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FORM PTO 1050 (Rev. 2-93)

11 AUG 2004

US006745816B2

(12) United States Patent

Ban et al.

(10) Patent No.: US 6,745,816 B2
(45) Date of Patent: Jun. 8, 2004

(54) METHOD OF CASTING AND CASTING MACHINE

(75) Inventors: Keisuke Ban, Nagano (JP); Akira Sunohara, Nagano (JP); Yasuhiro Sasaki, Nagano (JP); Koichi Ogiwara, Nagano (JP); Sakuzo Nakatani, Nagano (JP)

(73) Assignee: Nissin Kogyo Kabushiki Kaisha, Nagano (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/852,267

(22) Filed: May 10, 2001

(65) **Prior Publication Data**

US 2002/0003033 A1 Jan. 10, 2002

(30) **Foreign Application Priority Data**

May 10, 2000	(JP)	2000-137799
Jan. 25, 2001	(JP)	2001-016858
Jan. 30, 2001	(JP)	2001-021277

(51) Int. Cl.[7] B22D 27/00; B22D 27/18; B22C 3/00

(52) U.S. Cl. 164/56.1; 164/67.1; 164/122.1; 164/359

(58) Field of Search 164/56.1, 122.1, 164/359, 360, 61, 66.1, 67.1

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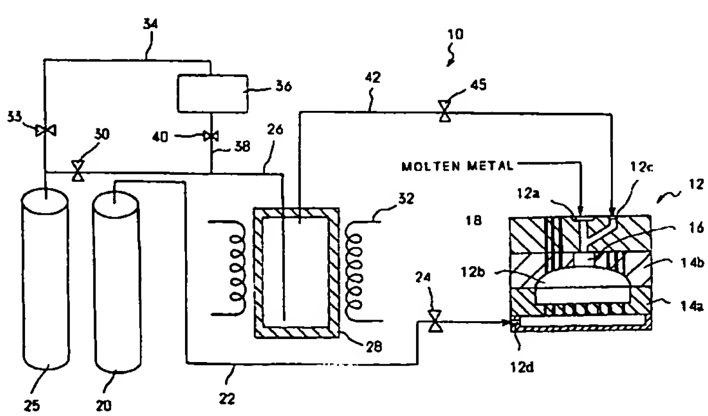
* cited by examiner

Primary Examiner—Kuang Y. Lin
(74) *Attorney, Agent, or Firm*—McGuireWoods LLP

(57) **ABSTRACT**

The method of casting of the present invention is capable of making volume of a feeder head can be small and making cooling rate of the feeder head can be easily made lower than that of a cavity. The method is executed in a casting machine, which includes a casting die, in which the feeder head is provided between a metal inlet and the cavity and in which heat insulating of the feeder head is greater than that of the cavity so as to make cooling rate of the feeder head lower than that of the cavity. The method comprises the steps of: pouring a molten metal into the cavity; reacting the molten metal on a deoxidizing compound in the cavity so as to deoxidize an oxide film formed on a surface of the molten metal; and supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked.

20 Claims, 8 Drawing Sheets



the heat insulating of the feeder head **16** can be made greater than that of the cavity **12***b*, which is formed in the lower and the upper dies **14***a* and **14***b*, without applying the heat insulating lubricant on the inner faces of the feeder head **16**.

When the molten metal in the feeder head **16** is pressed as shown in FIG. **5**, an heat insulating plate **37** (see FIG. **7**), whose heat conductivity is lower than that of the metallic dies **14***a* and **14***b*, may be provided between the adapter **18** and the upper die **14***b*. In this case, the feeder head **16** is formed by the heat insulating plate **37** and the upper die **14***b*.

The hear insulating plate **37** can be detached from the adapter **18**, and the heat insulating plate **37** can be detached from the upper die **14***b*. With this structure, the adapter **18** is detached and the molten metal in the feeder head **16** can be pressed by the pressing means, e.g., the piston **35** (see FIG. **5**), when the molten metal in the cavity **12***b* is solidified.

The hear insulating plate **37** may be made of baked calcium sulfate. As shown in FIG. **7**, volume of a part of the feeder head **16** formed in the plate **37** is greater than that of the other part of the feeder head **16** formed in the upper die **14***b*. With this structure, the heat insulating of the feeder head **16** can be made greater than that of the cavity **12***b*, which is formed in the metallic dies **14***a* and **14***b*, without applying the heat insulating lubricant on the inner faces of the feeder head **16**.

In the casting die **12** shown in FIGS. **1**–**2B** and **5**–**7**, the adapter **18** and the heat insulating plate **37** are made of the baked calcium sulfate, but they may be made of metals or ceramics.

Note that, in the case of employing the metallic adapter **18** or the metallic plate **37**, in which the feeder head **16** is substantially formed, the inner face of the feeder head is coated with the heat insulating lubricant so as to make the heat insulating of the feeder head **16** greater than that of the cavity **12***b*.

As shown in FIG. **7**, the furnace **28** shown in FIG. **1** may be provided immediately above the metallic gas inlet **12***c* of the casting die **12**. In another case, a reaction chamber **39**, in which the magnesium gas, which is an example of the metallic gas, is reacted on the nitrogen gas, which is an example of the reacting gas, so as to produce the magnesium nitride compound (Mg_3N_2), which is an example of the deoxidizing compound, may be provided immediately above the metallic gas inlet **12***c* of the casting die **12**.

When the aluminium product is cast in the casting die **12** shown in FIGS. **1**–**7**, temperature of the inner faces of the cavity **12***b* is lower than 320° C., which is temperature of the inner faces of the cavity of the conventional casting die. In the present invention, the temperature of the inner faces of the cavity **12***b* is maintained less than 300° C. while casting, preferably less than 230° C., more preferably less than 200° C.

By making the temperature of the inner faces of the cavity **12***b* of the casting die **12** lower, the casting machine of the present invention has many advantages: the cooling rate of the molten metal can be made higher; the molten metal can be uniformly solidified; the volume of the feeder head **16** can be reduced; tough products can be cast; cycle time of casting can be shorter; casting efficiency can be improved; and life span of the casting die can be longer.

If the temperature of the inner faces of the cavity **12***b* is higher than the prescribed temperature, the casting die **12** should be compulsorily cooled. For example, the casting die **12** can be cooled by a cooling unit **47** shown in FIG. **8**. The cooling unit **47** includes water jackets **12***e*, which is provided to the casting die **12** and in which water or oil is circulated. The temperature of the casting die **12** is measured by proper means, e.g., a thermocouple, and the cooling unit **47** is driven when the measured temperature is higher than the prescribed temperature so as to maintain the temperature of the casting die **12** in a predetermined temperature range.

In the case of compulsorily cooling the casting die **12**, the lowest temperature of the inner faces of the cavity **12***b* is not limited, so it may be the room temperature. Preferably, the temperature range is defined so as to economically operating the cooling unit **47**.

If the temperature of the inner faces of the cavity **12***b* is higher than the prescribed temperature in spite of employing the cooling unit **47** shown in FIG. **8**, cold water, which have been cooled by a cooler **64** (see FIG. **9**) may be circulated in the water jackets **12***e*. In the cooling unit **47** shown in FIG. **9**, the cold water is once reservoired in a tank **60** and circulated in the water jackets **12***e* by a pump **62**. The water in the tank **60** is cooled by the cooler **64**, whose structure is publicly known. In some cases, the cooler **64** cools to temperature of −25° C., so antifreezing solution is employed instead of water.

By employing the cooling unit **47** shown in FIG. **9**, the temperature of the inner faces of the cavity **12***b* can be maintained lower than the room temperature, so that the solidification of the molten metal in the cavity **12***b* of the casting die **12** can be accelerated and crystal structures, e.g., dendrites, of the solidified metal are made finer. Further, the molten metal is rapidly cooled, so that the crystal structures are made close and compact and hardness of the cast products can be improved.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed is:

1. A method of gravity die casting in a casting machine including a casting die, in which a feeder head is provided between a metal inlet and a cavity and in which heat insulating of the feeder head is greater than that of the cavity so as to make cooling rate of the feeder head lower than that of the cavity, said method comprising the steps of:

pouring molten metal into the cavity;

reacting the molten metal with a deoxidizing compound in the cavity so as to deoxidize an oxide film formed on a surface of the molten metal; and

supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked, more and the cooling rate of the feeder head is less than 500° C./min. (insert text)

2. The method according to claim 1,

wherein the molten metal is aluminum or aluminum alloy,

the cooling rate of the molten metal in the cavity is adjusted to make average dendrite ~~spacings~~ of solidified aluminum or aluminum alloy in the cavity less than 25 μm, and spacing

the cooling rate of the molten metal in the feeder head is adjusted to make average dendrite spacing of solidified aluminum or aluminum alloy in the cavity 25 μm or more.

3. The method according to claim 1,

wherein an inner face of the feeder head is coated with heat insulating lubricant, and

an inner face of the cavity is free of heat insulating lubricant.

4. The method according to claim 1,

wherein the heat insulating of a material of the casting die, which forms the feeder head, is greater than that of a material of the casting die, which forms the cavity.

5. The method according to claim 1,

wherein temperature of an inner face of the cavity is less than 300° C. while casting.

6. The method according to claim 1,

wherein an inner face of the cavity is compulsory cooled by cooling means.

7. The method according to claim 1,

wherein an adapter of the casting die is detachably attached to a cavity part of the casting die.

8. The method according to claim 1,

wherein an adapter of the casting die includes: the feeder head; a first path for introducing the molten metal to the feeder head; and a second path for introducing a material of the deoxidizing compound to the cavity so as to form the deoxidizing compound in the cavity.

9. The method according to claim 1,

wherein the molten metal is aluminum or aluminum alloy, and the deoxidizing compound is magnesium nitride compound, which is formed by reacting a magnesium gas on a nitrogen gas.

10. A method of gravity die casting in a casting machine including a casting die, said method comprising the steps of:

pouring molten metal into a cavity of the casting die by pouring molten metal through a feeder head;

setting a cooling rate of the molten metal filled in an uncoated area of the cavity at about 500° C./min. or more and a cooling rate of the molten metal poured into the feeder head portion at about 500° C./min. or less to provide an average dendrite size to increase fluidity and toughness;

reacting the molten metal with a deoxidizing compound in the cavity so as to deoxidize an oxide film formed on a surface of the molten metal;

solidifying the molten metal filled in the cavity; and

supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked.

11. The method according to claim 10, wherein:

an inner wall surface of the cavity is free from the heat insulating treatment; and

coating the feeder head with a heat insulating lubricant.

12. The method according to claim 10, further comprising:

introducing a first substance and carrier agent into another path in the feeder head to enter into the cavity;

introducing a second substance directly into the cavity,

wherein the first substance and the second substance form the deoxidizing compound on walls of the cavity prior to the pouring step.

13. A method according to claim 12, wherein the carrier agent and first substance are mixed in a heated receptacle and the carrier agent transfers the first substance from the heated receptacle to the cavity.

14. The method according to claim 10, wherein:

the molten metal is aluminum or an aluminum alloy, and

a magnesium-nitrogen compound which is obtained by allowing a magnesium gas and a nitrogen gas as raw materials to be reacted with each other in the cavity is used as the deoxidizing compound.

15. The method according to claim 10, wherein in the solidifying step, a difference of a cooling rate between the molten metal filled in the feeder head and the molten metal filled in the cavity is set to be about 200° C./min or more.

16. The method according to claim 10, further comprising preventing a blocking of the deoxidizing compound by arranging a molten metal-introducing passage that introduces the molten metal into the feeder head and an introducing passage that introduces a raw material of the deoxidizing compound into the cavity.

17. The method according to claim 10, wherein the cooling rate of the molten metal filled in the cavity at about 500° C./min. or more and the cooling rate of the molten metal poured into the feeder head at less than 500° C./mm fully secures the difference of solidification time of the molten metal between the molten metal filled in the feeder head and the molten metal filled in the cavity.

18. A gravity die casting method, comprising the steps of;

pouring molten metal into a cavity of the a molding die;

reducing an oxide film formed on a surface of the molten metal by allowing the molten metal and a substance of the deoxidizing compound from a heated receptacle to flow into contact in the cavity;

reacting the molten metal with the deoxidizing compound, a substance of which is carried separately in the cavity, so as to deoxidize an oxide film formed on a surface of the molten metal;

solidifying the molten metal filled in the cavity, and

supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked.

19. A gravity die casting method, comprising the steps of:

pouring molten metal into a cavity of the a molding die;

forming a deoxidizing compound in the cavity by:

introducing a first substance in the cavity which acts to provide the cavity in a non oxidizing atmosphere, and

introducing a second substance in the cavity, separate, from the first substance, to mix with the first substance to form the deoxidizing compound;

reacting the molten metal with the deoxidizing compound in the cavity so as to deoxidize an oxide film formed on a surface of the molten metal;

solidifying the molten metal filled in the cavity; and

supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked.

20. A gravity die casting method, comprising the steps of:

pouring molten metal into a cavity of the a molding die;

providing a carrier agent into a heated receptacle which holds a substance of a deoxidizing compound, introducing the substance into the cavity by using the carrier agent to form the deoxidizing compound in the cavity;

reducing an oxide film formed on a surface of the molten metal by allowing the molten metal and the deoxidizing compound from a heated receptacle to flow into contact in the cavity;

reacting the molten metal with the deoxidizing compound in the cavity so as to deoxidize an oxide film formed on a surface of the molten metal;

solidifying the molten metal filled in the cavity, and supplementing the molten metal in the feeder head to the cavity when the molten metal in the cavity is solidified and shrinked.

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